

FY08-LXIV(64)-163

“Coal Ash Behavior in Reducing Environments (CABRE III)”

Submitted by: Energy & Environmental Research Center (EERC)

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PARTICIPANTS

Sponsors

U.S. Department of Energy (DOE)
Conoco Phillips
ND Industrial Commission (NDIC)

Cost Share

\$ 1,385,976
\$ 150,000
\$ 150,000

Total Cost \$1,685,976

Project Schedule - 3 Years

Contract Date – 6/23/08

Contract Signed: 6/23/08 (✓)
Amended 12/21/09(✓)
Start Date – 5/1/08
Completion Date – 8/31/11

Project Deliverables

Progress Reports as per amendment

12/31/09 (✓); 3/31/10 (✓); 6/30/10 (✓); 9/30/10 (✓);
12/31/10 (✓); 3/31/11 (✓); 6/30/11 (✓)
Final Report: 8/30/11 ()

OBJECTIVE / STATEMENT OF WORK:

Conduct research and demonstrate fuel ash-related problems that affect gasification performance and provide more reliable evaluation tools for gasifier design engineers and operators to assess coal requirements and optimize operating conditions.

STATUS:

May 1, 2008 – June 30, 2008: Contracts were established between EERC & DOE and EERC & NDIC. Discussions with additional prospective industry sponsors occurred.

July 1, 2008 – September 30, 2008: Efforts continued to secure additional industry sponsors. Work will not begin until at least four sponsors have committed to the project.

October 1, 2009 - December 31, 2009: During the quarter all contract agreements were signed between the EERC and DOE and the commercial sponsors. A kickoff meeting was held and the fuels for the program were selected. Two lignites from North Dakota are included. Analysis of the selected samples is under way. An extensive literature search has been completed to identify additional literature on the subject completed since the completion of CABRE phase II.

January 1, 2010 - March 31, 2010: Analytical measurements were completed for the sponsor fuels selected to date. Standard and advanced coal characterization methods were used to establish a baseline makeup for each fuel. Slag viscosity measurements also took place last quarter in the EERC's rotating bob viscometer.

April 1, 2010 - June 30, 2010: The detailed analysis of the two lignite coals has been completed. The coal from the Center Mine, Center, ND, was deliberately collected from an area of the mine with high Na content and does not represent the mine average. Work on the model development is progressing, with elements for predicting slag partitioning and viscosity selected. Work on slag flow and slag-refractory interaction is targeted for the next quarter.

July 1, 2010 - September 30, 2010: Gasification testing in the EERC EFG was performed with petroleum coke. Testing with Falkirk Mine (Underwood, ND) lignite is scheduled to be performed in early October. A method of empirically estimating the partitioning of coal ash to slag and fly ash had been previously determined. Modeling work is under way to provide more detailed partitioning information using scanning electron microscopy data. Work is also ongoing to define the input data required for the CABRE III model as well as the form of the input data.

October 1, 2010 - December 31, 2010: During this quarter test runs were completed on the four selected fuels. Successful runs were completed with both lignite samples in the entrained flow gasifier. A successful run with the fluidized bed gasifier was also completed with the Falkirk Lignite sample. Samples were collected and more detailed analysis is under way. Analysis is being completed using a new more powerful Scanning Electron microscope called QEMSCAN. This technique allows for significantly more information to be gathered which it is hoped will greatly enhance the data generated and hence the understanding of the critical inorganic transformations involved. Problems were noted in the testing with the less reactive petroleum coke sample leading to poor carbon conversion numbers for these samples.

Work on the model development activities has focused on the "best available" models for using compositions to predict physical properties of the ashes and slags. This activity continues.

January 1, 2011 - March 31, 2011: Work this quarter has included testing of slag/ refractory interactions to determine challenges as coal ash is partitioned between the gaseous and liquid phases at high temperatures. The coal ash used was obtained using coal from the Falkirk Mine. Pilot-scale gasification tests were completed on a combination of petroleum coke and Illinois Basin coal using the entrained flow gasification system. Operation was initiated with only petroleum coke fluxed with a sub bituminous coal ash, then a bituminous coal only run, and finally testing with the bituminous coal under more reducing conditions. Analysis of the data continues. A model shell has been successfully developed. Work continues to gather more data on ash partitioning and translating the data on ash partitioning from a spreadsheet to a computer-based model.

April 1, 2011 - June 30, 2011: Work this quarter has focused on detailed analysis of selected full-scale gasifier slag, entrained ash and coal samples to develop partitioning data for model development and validation. Samples were obtained from two full-scale gasifiers, a cyclone boiler (this operates in a reducing environment) and samples from the EERC's entrained flow and fluid bed pilot-scale gasification facilities. Analysis of this data was completed and has been used to develop a spreadsheet-based model as a first step. The goal is to have a working stand-alone computer model. The model will run as an executable file on any Windows-based PC.